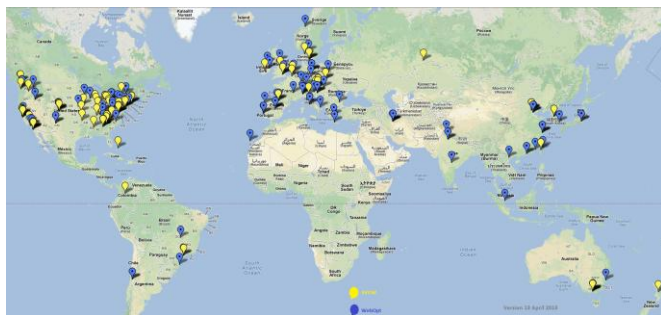
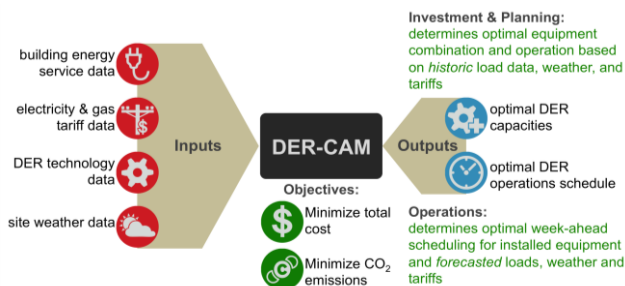


Microgrid Research at Berkeley Lab

The microgrid team at Berkeley Lab studies customer adoption patterns of grid technology and distributed energy resources (DER) optimization in microgrids and buildings. Since 2000, the team has been developing the Distributed Energy Resources Customer Adoption Model (DER-CAM). DER-CAM is a tool that outputs microgrid investment and dispatch results that minimize costs or emissions. The graphic below left shows a high level schematic of the model and the right one the worldwide distribution of users of different DER-CAM versions. Currently, 12 different DER-CAM versions are available (deterministic, stochastic dynamic programming, predictive control, etc.) and used for microgrid adoption, policy analyses, and microgrid controller design. See also <http://building-microgrid.lbl.gov/sites/all/files/projects/DER-CAM-Feature-List.pdf>



Selection of Current Projects

Web-Optimization of Distributed Energy Resources (WebOpt)

WebOpt provides a web service for academic users to evaluate potential DERs as fuel cells, combined heat and power (CHP), electric/heat storage, heat pumps, absorption chiller, PV, solar thermal options, etc. in buildings/microgrids. US load and solar databases are included for easy usage. See <http://building-microgrid.lbl.gov/projects/how-access-der-cam>.

University of New Mexico Thermal System Optimization

The Mechanical Engineering building on the UNM campus in Albuquerque has a complex thermal system. Approximately 225 m² of solar thermal collectors supply hot water to a 70 kW absorption chiller, or charge a 30 m³ hot water storage tank. Additionally, a huge 350 m³ of chilled water storage is available. A load forecasting and predictive DER-CAM model of this system has been built and runs daily on Berkeley Lab's server. A rolling 7-day ahead dispatch schedule is delivered over the web to UNM, and is fed automatically into the building's energy management and control system. This schedule determines the operation of the absorption chiller and charging and discharging of the storage. A 30% cost reduction can be achieved with this predictive tool.

Current Research Partners

Honeywell, C3 Energy, NEC Labs America, University of New Mexico, U.S. Air Force, Public Service New Mexico, Tri-Technic

California CHP Potential

The goal of this project is to stimulate economic and environmentally sound natural gas-fired CHP and combined cooling, heating, and power (CCHP) adoption in California's commercial building sector by 2030.

- ✓ Developed multiple scenarios that reflect grid decarbonization, changes in equipment performance, and regulatory environment.
- ✓ Considered zero net energy buildings and their impact on CHP and CCHP.
- ✓ Considered different feed-in tariffs and the impact of CO₂ pricing and cap and trade on CHP/CCHP adoption.

Results for example show that natural-gas-fired CHP is cost effective, even in zero net energy buildings.

International Microgrid Symposiums

In addition to research, the team organizes the annual microgrid symposium series, now in its 10th year. Leading experts in academia, industry, and governments meet to exchange microgrid research and demonstration results from around the world, and to identify areas of potential international cooperation and dissemination.

Other Projects

- ✓ Passive measures in DER-CAM (Thermodynamics)
- ✓ Stochastic Electric Vehicle Fleet Management
- ✓ Non-linear Efficiency Curves in DER-CAM
- ✓ Multi-year DER Decision Support System
- ✓ Collaboration with C3 Energy on DER/utility perspectives
- ✓ Microgrid Design tool together with Sandia Nat. Laboratory
- ✓ Collaboration with Berkeley Lab's China Energy Group on Energy System Planning & Grid Integration in China
- ✓ Vehicle to Grid demonstration project at the Los Angeles Air Force Base
- ✓ Microgrid Controller design at Fort Hunter Liggett together with Tri-Technic